Marine Recreational Information Program Report
FY-2018

Evaluating Nonresponse Bias in the MRIP Fishing Effort Survey

Project: Evaluating Nonresponse Bias in the MRIP Fishing Effort Survey

Rob Andrews - Author, *NOAA Fisheries, Office of Science and Technology*

Table of Contents

1. Is it Influential Scientific Information?
2. Has it had sufficient Peer Review?
3. MRIP Certified
4. Report Title
5. Background
6. Executive Summary
7. Methods
8. Results
9. Discussion/Conclusions/Recommendations
10. References

1. Is it Influential Scientific Information?
N

2. Has it had sufficient Peer Review?
N

3. MRIP Certified

4. Report Title
Evaluating Nonresponse Bias in the MRIP Fishing Effort Survey

5. Background

FES Data Collection Design

The MRIP Fishing Effort Survey (FES) is a bi-monthly, cross-sectional mail survey designed to estimate the total number of private boat and shore-based recreational, saltwater fishing trips taken by residents of coastal states. Papacostas and Foster (2018) provide a full description of the data collection and estimation designs.

Sampling

For each administration, the FES utilizes address-based samples (ABS) derived from the USPS Computerized Delivery Sequence File (CDS). The sample frame includes all full-time (non-seasonal), residential addresses, with the exception of PO boxes that are not flagged as the only way to get mail. Sampling is stratified both geographically and by angler license status. Within each state, sampling is stratified into coastal and non-coastal sub-state regions defined by geographic proximity to the coast. Generally, counties with borders that are within 25 miles of the coast are in the “coastal” stratum and all other counties are in the “non-coastal” stratum. Within the geographic strata, addresses are matched to the National Saltwater Angler Registry (NSAR), which consists of state lists of licensed saltwater anglers. This creates two additional strata; license matched (households with one or more licensed anglers) and license unmatched (households that cannot be matched to NSAR). Within each stratum, addresses are selected in a single stage using simple random sampling.

Data Collection

Each year, the survey is administered for six, two-month reference waves. The data collection period for each wave begins one week prior to the end of the wave with an initial survey mailing. The timing of the initial mailing is such that materials are received prior to the end of the reference wave. The initial mailing is delivered by regular first class mail and includes a cover letter stating the purpose of the survey, a survey questionnaire, a post-paid return envelope, and a $2.00 prepaid cash incentive. One week following the initial mailing, a thank you/reminder postcard is sent via first class mail to all sample units. Three weeks after the initial survey mailing, a follow-up mailing is delivered to all sample units that have not responded to the survey. The follow-up mailing is delivered via first class mail and includes a nonresponse conversion letter, a second questionnaire and a post-paid return envelope.

Weighting

Final FES weights are calculated in stages. In the first stage, the base sample weight within each stratum is calculated as the inverse of the inclusion probability. In the second stage, base weights are adjusted to compensate for unit nonresponse. The sample is partitioned into nonresponse adjustment cells, or weighting classes, by state, sub-state region (coastal or non-coastal), saltwater fishing license match (matched or unmatched), and boat ownership registration (e.g. whether a sampled address could be matched to state boater registration list). The base weights of the respondents in each adjustment cell are then divided by the response rate for that cell to calculate the adjusted weights. In the third stage, nonresponse weights are further adjusted through a process known as raking, which adjusts weights so that the separate or marginal distributions for select variables in the sample data conform to corresponding distributions from independent data sources (Brick and Kalton 1996). For the FES, auxiliary variables are derived from the American Community Survey, Current Population Survey and National Health Interview Survey, and include households with seniors, households with children, household tenure (own/rent), households with three or more household members, and wireless-only households. During the fourth stage, raked weights are post-stratified to account for incomplete coverage of the target population. Post-stratification is commonly used to make respondent data conform to target population totals from other sources independent from the survey (Brick and Kalton 1996). The most recent estimates of the number of residential households available from the American Community Survey (United States Census Bureau 2016) are used as population control totals. Raked weights are post-stratified to household-level control totals within coastal and non-coastal strata (as defined at the time of sampling for each wave).

Previous Evaluation of Nonresponse Bias in the FES

We previously completed a nonresponse follow-up in 2012-2013 (Andrews et al. 2014). Results from that study, which was conducted in MA, NY, NC and FL, found no significant differences in reported fishing activity between initial FES respondents and NRFU respondents.

FES Response Rates

In 2019, the FES achieved an overall, weighted response rate (AAPOR, RR2) of approximately 31%. Among states, response rates ranged from 27% to 40%. Given the potential for nonresponse bias, we implemented a second follow-up study to evaluate nonresponse bias in the FES.

6. Executive Summary

NA

7. Methods

The FES Nonresponse Follow-up (NRFU) was administered in MA, NY, NC and FL during waves 4 (Jul/Aug) and 5 (Sep/OCT), 2020. All addresses that hadn't responded to the base FES survey within five weeks of the final survey mailing were eligible for the NRFU. From these

nonresponding addresses, we sub-sampled at a rate of approximately 77%, resulting in a total NRFU sample of 15,993 addresses. Table 1 provides NRFU sample sizes by state and wave.

Table 1. NRFU sample sizes by state and wave.

State	Wave 4	Wave 5	Total
FL	1,058	1,177	2,235
MA	937	2,223	3,160
NY	3,219	4,034	7,253
NC	1,602	1,743	3,345
Overall	6,816	9,177	15,993

Following data collection, returned NRFU questionnaires were processed according to standard FES specifications. NRFU selection weights that reflected sub-sampling rates were calculated, as were revised final weights that reflected all completed surveys, including both base FES and NRFU questionnaires. Comparisons of demographic characteristics and reported fishing activity were made between base FES and NRFU samples, as well as between base FES and full samples that include both base and NRFU responses (FES+). Table 2. Base FES and NRFU data collection scheduleNRFU data collection was initiated six weeks after the final FES contact for each wave with the delivery of an advanced letter via regular first-class mail. Five days later, a survey packet, including a cover letter, questionnaire, business reply envelope and a $5.00 cash incentive was delivered via FedEx. A final postcard thank you/reminder was sent 10 days after the survey packet. The NRFU utilized the standard FES, Weather and Outdoor Activity Survey questionnaire, and all survey communications were modified to stress the importance of the survey. The data collection schedule for the base FES and NRFU is provided in table 2.

Table 2. Base FES and NRFU data collection schedule

Data Collection Activity	Wave 4	Wave 5
Initial FES Mailing	August 25, 2020	October 26, 2020
FES Postcard	September 1, 2020	November 2, 2020
FES Follow-up Mailing	September 18, 2020	November 19, 2020
NRFU Pre-notice	October 27, 2020	December 28, 2020
NRFU Questionnaire	November 2, 2020	January 4, 2021
NRFU Postcard	November 12, 2020	January 14, 2021

8. Results

Overall, the base FES achieved a weighted response rate of 27.90% in the study states during study period. The overall NRFU response rate was 21.85%, and the overall response rate, including both base FES and NRFU samples was 42.44%. Table 3 provides total sample sizes, the number of completed surveys and weighted response rates by data collection stage and state.

Table 3. Sample size, number of responses and weighted response rate (AAPOR 2) overall and by state for each data collection phase. Response rates were calculated using selection weights, which included a sub-sampling factor for the NRFU sample. The denominator in the response rate calculation includes all sampled addresses, including addresses returned by the

Postal Service as not delivered. Excluding not delivered addresses from the response rate calculation results in an overall response rate of 45.4%.

	Base FES			NRFU			Overall	
State	Sample Size	Responses	Response Rate	Sample Size	Responses	Response Rate	Responses	Response Rate
FL	4,222	1,238	28.02	2,235	513	22.42	1,751	42.58
MA	6,143	2,010	31.51	3,160	774	24.27	2,784	46.95
NY	11,956	2,714	26.11	7,253	1,343	19.7	4,057	39.83
NC	6,329	2,006	28.39	3,345	826	23.08	2,832	43.71
Overall	28,650	7,968	27.90	15,993	3,456	21.85	11,424	42.44

We used multiple logistic regression to compare demographic characteristics and other household attributes between base FES and NRFU respondents (Table 4). Analysis weights accounted for selection probabilities but were not adjusted to account for differential nonresponse. Households with seniors, households owned by the occupant and households with a registered boat were significantly more likely to respond to the base FES survey request than the NRFU. Wireless only households and black-alone households were significantly less likely to respond to the base FES survey request than the NRFU (i.e. these households were more likely to require additional follow-up prior to responding). Notably, neither boat nor shore fishing activity were significant response predictors, suggesting that fishing behaviors for base FES and NRFU respondents were not different.

Table 4. Multiple logistic regression predicting response to the initial, base FES survey request (1) or the follow-up, nonresponse request (0).

Household/Population Attribute	Adjusted Odds Ratio (95% CI)
Senior in Household (%)	1.182 (1.09 - 1.37)*
Child in Household (%)	0.955 (0.788 - 1.159)
Wireless Only (%)	0.856 (0.745 - 0.983)*
Own Home (%)	1.169 (1.003 - 1.361*
3+ Household Members (%)	0.872 (0.734 - 1.035)
White Alone (%)	1.018 (0.84 - 1.234)
Black Alone (%)	0.747 (0.57 - 0.979)*
Hispanic (%)	0.876 (0.722 - 1.063)
Households with Saltwater License (%)	1.044 (0.895 - 1.218)
Households with Registered Boat (%)	1.31 (1.014 - 1.692)*
Households with Boat Fishing (%)	1.086 (0.835 - 1.412)
Households with Shore Fishing (%)	0.981 (0.774 - 1.243)

Table 5. Estimated demographic characteristics and fishing activity for base FES and FES + NRFU (FES+) samples. Estimates were derived from selection weights (base weights). Relative differences are between FES and FES+ estimates.

Household/Population Attribute	Control	FES	FES+	Relative Difference	Significance of Difference
Senior in Household (%)*	33.9	44.3	41.6	6.0	0.0115

Child in Household (%)*	27.5	21.0	22.6	-7.6	0.0619
Wireless Only (%)*	50.2	58.4	60.4	-3.4	0.0537
3+ Household Members (%)*	35.3	33.6	35.5	-5.8	0.0469
Own Home (%)*	61.2	77.5	75.7	2.3	0.0383
Black Alone (%)	16.2	7.8	8.5	-9.5	0.189
White Alone (%)	76.5	81.1	79.7	1.7	0.0893
Hispanic (%)	13.6	13.9	15.2	-9.0	0.1136
Households with Registered Boat (%)	5.7	8.8	8.0	8.8	0.1746
Households with Saltwater License (%)	7.9	10.3	9.8	4.3	0.2712
Households with Boat Fishing (%)	NA	7.8	7.5	2.7	0.6708
Mean Boat Fishing Days per Household	NA	7.6	7.5	0.7	0.9334
Households with Shore Fishing (%)	NA	9.1	8.9	2.2	0.7141
Mean Shore Fishing Days per Household	NA	8.7	8.4	3.5	0.6857

We also compared estimates of these measures between the base FES sample and the full sample (FES+) that included both base FES and NRFU respondents (Table 5). In addition to survey measures, table 5 includes population control values obtained from the American Community Survey, Current Population Survey and administrative records. For estimates derived with selection weights, absolute relative differences between FES and FES+ for these attributes ranged from 1.7% to 9.5%. Differences between FES and FES+ were significant for households with seniors, households with 3+ occupants, and households owned by the occupant. FES+ estimates are more similar to control values for 8 of 10 attributes. Base FES estimates are closer to control values for wireless-only households and households with Hispanic residents. For measures of fishing activity, FES estimates were higher than FES+ estimates, but differences were small and not significant.

Table 6. Estimated demographic characteristics and fishing activity for base FES and FES + NRFU (FES+) samples. Estimates were derived from final adjusted weights. Relative differences are between FES and FES+ estimates.

Household/Population Attribute	Control	FES	FES+	Relative Difference	Significance of Difference
Senior in Household (%)*	33.9	34.0	34.0	0.0	0.9757
Child in Household (%)*	27.5	27.5	27.5	0.0	0.9863
Wireless Only (%)*	50.2	49.7	49.7	0.0	0.9977
3+ Household Members (%)*	35.3	35.2	35.2	0.0	0.9993
Own Home (%)*	61.2	61.6	61.5	0.2	0.9287
Black Alone (%)	16.2	10.8	11.5	-6.5	0.383
White Alone (%)	76.5	75.5	75.2	0.4	0.6427
Hispanic (%)	13.6	15.1	16.0	-6.0	0.3505
Households with Registered Boat (%)	5.7	4.6	4.6	0.0	0.9345
Households with Saltwater License (%)	7.9	7.4	7.2	2.7	0.4456
Households with Boat Fishing (%)	NA	6.7	6.5	3.0	0.7254
Mean Boat Fishing Days per Household	NA	6.8	7.0	-2.9	0.728
Households with Shore Fishing (%)	NA	8.4	8.2	2.4	0.6684

Mean Shore Fishing Days per Household	NA	8.5	8.3	2.4	0.8026

For these weighting variables, differences between FES and FES+, as well as differences between estimated distributions (FES and FES+) and control values were essentially eliminated (Table 6). Weighting adjustment also reduced differences between FES and FES+ estimates for all of the remaining variables. For these attributes, including black-alone households, white-alone households, Hispanic households, households matched to a state boater registration list and households matched to a state saltwater fishing license list, absolute relative differences between FES and FES+ ranged from 0-6.5%, and none of the differences were significant. With the exception of Hispanic households, weighting also reduced the differences between estimated and control values for these variables. For Hispanic households differences between estimated and control values remained within three percentage points following weighting adjustments. Weighting adjustments had little impact on comparisons between FES and FES+ for measures of fishing activity. Additional discussion about the effect of weighting adjustments on estimated fishing activity is provided below.The FES weighting methodology includes both nonresponse adjustment and calibration to population control values. Saltwater fishing license and boat registration records are auxiliary/administrative data included in the nonresponse adjustment. Specifically, weight adjustments are made within cells defined by state/sub-state/license match/boat registration match. This approach assumes that nonrespondents are missing at random within adjustment cells (Brick and Kalton 1996). Following nonresponse adjustment, weights are further adjusted to match marginal control distributions for households with seniors, households with kids, households with 3+ residents, wireless-only households and households owned by the occupant (values designated by an asterisk in Table 5 and Table 6).

We used multiple logistic regression to predict private boat (Table 7) and shore (Table 8) fishing behavior from the attributes of responding household. Table 7 provides adjusted odds ratios predicting boat fishing activity. Household characteristics that significantly increased the odds of reporting boat fishing include white-alone, three or more residents, having a registered boat and matching to a saltwater fishing license. Having a senior resident is the only attribute that significantly decreased the odds of reporting boat fishing. Results for shore fishing were similar, except that white-alone was not a significant predictor of fishing activity (Table 8). This evaluation assumes that relationships between fishing activity and household characteristics are similar for respondents and nonrespondents. Weighting adjustments will reduce nonresponse bias if the adjustment variables are correlated with both response propensity and survey measures. From table 5, we observed that the unadjusted sample over-represents households with seniors, wireless-only households, owner-occupied households, white-alone households, households with a registered boat and households that matched to a saltwater fishing license. Conversely, the sample under-represents households with kids and black-alone households. The full sample that included NRFU respondents (FES+) was more similar to population controls, but differences remained. Differential response propensities among demographic groups will result in biased estimates if fishing activity correlates with these characteristics.

Table 7. Adjusted odds ratios predicting boat fishing activity.

Household/Population Attribute	Adjusted Odds Ratio (95% CI)

Senior in Household	0.633 (0.481 - 0.833)*
Child in Household	0.780 (0.566, 1.074)
Wireless Only	1.032 (0.809, 1.316)
Own Home	1.118 (0.799, 1.565)
3+ Household Members	2.017 (1.5, 2.713)*
White Alone	2.144 (1.532, 3)*
Black Alone	1.148 (0.603, 2.184)
Hispanic	1.006 (0.715, 1.416)
Households with Registered Boat	4.038 (3.146, 5.182)*
Households with Saltwater License	5.076 (4.182, 6.161)*

Table 8. Adjusted odds ratios predicting shore fishing activity

Household/Population Attribute	Adjusted Odds Ratio (95% CI)
Senior in Household	.0712 (0.554, 0.917)*
Child in Household	1.088 (.0798, 1.484)
Wireless Only	1.041 (0.842, 1.285)
Own Home	1.0 (0.751, 1.33)
3+ Household Members	1.75 (1.311, 2.336)*
White Alone	0.927 (0.673, 1.276)
Black Alone	0.659 (0.387, 1.125)
Hispanic	0.855 (0.621. 1.176)
Households with Registered Boat	1.729 (1.342, 2.228)*
Households with Saltwater License	5.307 (4.437, 6.349)*

The correlation between response propensity and fishing behavior for several household characteristics will result in biased estimates if not accounted for through weighting adjustments. For example, white-alone households, households with a registered boat and households with a licensed angler were 2-5 times more likely to report boat fishing than were households without these attributes. Over-representation in the respondent sample of households with these characteristics will result in an over-estimate of boat fishing effort. The difference between adjusted and unadjusted estimates is a measure of the extent to which weighting adjustments mitigate bias in the FES. Table 9 demonstrates that weighting adjustments reduced boat prevalence by 13.5% and 13.8% and shore prevalence by 8% and 8.2% for FES and FES+ samples, respectively. Weighting adjustments had less effect on estimates of mean boat and shore fishing days; weighting reduced mean boat days by 10.1% and 6.8% and mean shore days by 2% and 0.8% for FES and FES+, respectively.

Table 9. Estimated fishing activity for base FES and FES + NRFU (FES+) samples. Estimates were derived from both selection weights (base weights) and final analysis weights that were adjusted for nonresponse and post-stratified to conform to population control values.

Household/Population Attribute	FES			FES+		
	Selection Weights	Final Weights	Relative Difference (%)	Selection Weights	Final Weights	Relative Difference (%)
Households with Boat Fishing (%)	7.8	6.7	13.5	7.5	6.5	13.8
Mean Boat Fishing Days per Household	7.6	6.8	10.1	7.5	7.0	6.8
Households with Shore Fishing (%)	9.1	8.4	8.0	8.9	8.2	8.2
Mean Shore Fishing Days per Household	8.7	8.5	2.0	8.4	8.3	0.8

9. Discussion/Conclusions/Recommendations

Results from this study were similar to those reported by Andrews et al. (2014) – households that responded to the FES after additional contact attempts and a larger incentive were not significantly different from base respondents with respect to fishing activity. Similar percentages of FES and NRFU respondents reported fishing activity, and fishing households reported a similar number of fishing days for both private boat and shore fishing modes.

The follow-up mailings successfully solicited responses from a more diverse population of households than the base FES. Households that responded to the NRFU were more likely to be wireless only and identify black as the only race in the household, and less likely to include seniors, own their home or have a registered boat. Consequently, the full sample that included all respondents (base FES + NRFU) was generally more similar to population control values than the base FES samples. However, differences between samples in household characteristics did not impact primary survey measures – difference between FES and FES+ were not significant for any estimate of fishing activity.

Comparisons between selection-weighted sample distributions and control values revealed that the FES sample is biased with respect to certain household characteristics. FES samples are under-represented by households with children and black-alone households and over-represented by households with seniors, owner-occupied households, wireless-only households, and white-alone households. These findings are similar to previous studies, which observed that mail survey samples over-represent seniors and non-Hispanic whites, and under-represent households with children (Link et al. 2006, Link and Mokdad 2006). FES samples are also over-represented by households with a registered boat and households that matched to a saltwater fishing license database.

Along with white-alone households, households with a registered boat and households with a matched saltwater fishing license were significantly more likely to report fishing than households without these characteristics. In contrast, households with seniors were less likely to report fishing than households without seniors. Because response and fishing are correlated for these variables, estimates based upon selection weights will be biased (Brick and Kalton 1996). The extent to which weighting adjustments reduce bias is evaluated by comparing estimates derived from selection weights to those derived from adjusted weights (table 9) – weighting adjustments reduced bias by 8-14% for fishing prevalence and 1-10% for mean days fished. The effect of weighting adjustments on estimates was greater for boat fishing than shore fishing, largely because boat registration is a much stronger predictor of boat fishing activity than shore fishing activity (Tables 7-8).

While this evaluation cannot eliminate nonresponse as a possible source of bias in the FES –

nonresponse persisted after additional mailings and a larger incentive – it is reassuring that base FES and NRFU respondents were not different with respect to fishing activity, despite differences in household characteristics between the two respondent groups. While the response rate remains an area of concern, these results replicate those from a prior study which achieved a much higher overall response rate (Andrews et al. 2014). In addition, the observed correlation between response propensity and fishing activity suggest that the FES weighting adjustments are effective in reducing bias resulting from differential response. Such adjustments are commonly used to mitigate nonresponse bias in cross-sectional household surveys (Brick and Kalton 1996, Kalton and Flores-Cervantes 2003).

10. References

Andrews, R., Brick, J.M., Mathiowetz, N. (2014). Development and testing of recreational fishing effort surveys: Testing a mail survey design. Retrieved 04/28/2021 from: https://www.st.nmfs.noaa.gov/pims/main/public?method=DOWNLOAD_FR_PDF&record_id=1179.

Brick, J.M., and Kalton, G. 1996. Handling missing data in survey research. Statistical Methods in Medical Research, 5, 215-238.

Kalton, G. and Flores-Cervantes, I. 2003. Weighting methods. Journal of Official Statistics, 19(2), 81-97.

Link, M., Battaglia, M.P., Frankel, M.R., Osborn, L. (2006). Address-based versus random-digit-dial surveys: comparison of key health and risk indicators. American Journal of Epidemiology, 164(10), 1019-25.

Link, M.W., and Mokdad, A. 2006. Can web and mail survey modes improve participation in an RDD-based national health surveillance? Journal of Official Statistics, 22(2), 293-312.

Papacostas, K.J. and Foster, J. 2018. National Marine Fisheries Service's Marine Recreational Information Program Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort. Retrieved 06/22/2021 from https://media.fisheries.noaa.gov/dam-migration/mrip_survey_design_and_statistical_methodspdf.pdf.